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Dr. Susan Chipman
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Dear Susan,

This letter is the sixth quarterly progress report for grant N00014-91-J-1532, entitled "On-Line Assessment of Expertise." It covers the period January 1, 1993 to March 31, 1993.

The main objective in this report period was to deal with the combinatorial explosion in the size of the belief networks needed to analyze regular problem solving behavior. As mentioned in our preceding quarterly progress reports, Olae's belief networks can get quite large and intractable with non-toy knowledge bases. We have three approaches for handling this problem:

- We improved our algorithm that builds a belief net incrementally so that it is only as large as it needs to be for the particular actions we observe the human to make. Unlike earlier attempts, this algorithm assigns the same probabilities to nodes as does the intractable but mathematically correct approach.
- We tested a well-known Monte Carlo technique (stochastic simulation, Pearl, 1986) for estimating probabilities on the nodes in very large belief networks. To this we have added three enhancements that improve the estimates. For simulated physics problem solving data, the combined technique rapidly converges on the correct probabilities.
- We have developed and tested a technique for simplifying complex Bayesian net structures. As the student solves several problems, the Bayesian model of what they know becomes ever more complex. At some point, this model will be too large to use. Our simplification technique uses statistical clustering (based on Martin & Billman, 1994) to reduce both the number of nodes and the number of links in the model.

Olae provides all three of these approaches as options for the assessor. On the one hand, the assessor who does not mind waiting can receive guaranteed assessments. However, if assessment must be rapid or must follow the student through hundreds of problems, the assessor will want to

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choose some subset of the heuristic aids.

Best regards,



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&
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